

## WORKSHEET – NEWTON'S 2<sup>ND</sup> LAW OF MOTION

1. A water skier has a mass of 79 kg and accelerates at  $1.4 \text{ m/s}^2$  [R]. What is the net force acting on him?  
 $110.6 \text{ N [R]}$
2. Page 73 #2
3. What is the mass of an object if it takes a net force of 32 N [N] to accelerate it at a rate of  $0.88 \text{ m/s}^2$  [N]?  
 $36.36 \text{ kg}$
4. Page 73 #4
5. A box has a mass of 68 kg. An upward force of 777 N is applied to it.
  - a. Draw a free-body diagram showing the forces acting on the box while it is being lifted. Neglect air resistance.
  - b. What is the weight of the box?  
 $666.4 \text{ N [↓]}$
  - c. What is the net force acting on the box?  
 $110.6 \text{ N [↑]}$
  - d. What is the acceleration of the box?  
 $1.63 \text{ m/s}^2$  [↑]
6. A car has a mass of 820 kg. It starts from rest and travels 41 m in 3.0 s. Determine the net force applied to the car.  
 $7470 \text{ N}$
7. Page 73, #6
8. A net force of 15 N [fwd] is applied to a cart with a mass of 2.1 kg.
  - a. What is the acceleration of the cart?
  - b. How long will it take the cart to travel 2.8 m, starting from rest?  
 $0.886 \text{ s}$
9. What is the net force required to lift a full grocery bag with a mass of 20 kg,
  - a. Uniformly  
 $196 \text{ N}$
  - b. Upward at  $1.5 \text{ m/s}^2$ ?  
 $226 \text{ N}$
10. What will be the velocity of a 5.0 g bullet if a net force of 45 N [fwd] is applied to it over a distance of 0.80 m? The bullet started from rest.  
 $120 \text{ m/s}$
11. Neglecting air resistance, all objects fall towards Earth at  $9.8 \text{ m/s}^2$ . Anna Litical was overheard saying that this is because the force of gravity on, say, a bowling ball, is the same as that on a marble. Is she correct? Defend your position.
12. Consider an object in free-fall. We will also consider air-resistance. Air resistance is proportional to the speed of the object.
  - a. Initially, the weight of the object is greater than the air resistance it experiences. Describe the motion of the object.
  - b. At a later time, the air resistance has increased but the weight of the object still exceeds the air resistance. Describe the motion of the object and compare it to that in (a).
  - c. Eventually, the air resistance will be the same as the weight of the object. Describe the object's behaviour at this moment.
  - d. Let's assume that a 2.0 g raindrop started to fall from a cloud 500 m above the ground.
    - i. If there were no air resistance, with what force would it strike your head (located 1.80 m above the ground)?  
 $0.0196 \text{ N}$
    - ii. If there were no air resistance, with what velocity would it strike your head?  
 $356 \text{ km/h}$
13. A box with a *weight* of 22 N falls through the air with an air resistance of 14 N.
  - a. Draw an FBD.
  - b. Determine the net force acting on the box.  
 $8 \text{ N [down]}$
  - c. Determine the mass of the box and then its acceleration.  
 $3.57 \text{ m/s}^2$  [down]